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# S190 INTERPRETATION TECHNIQUES DEVELOPMENT AND APPLICATION TO NEW YORK STATE WATER RESOURCES

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The objective of this investigation is development of interpretation techniques for satellite monitoring of lake eutrophication. Imagery from the S190A and S190B experiments is to be utilized to study eutrophication processes in three lakes important to New York State water resources: Lake Ontario, Conesus Lake and Chautauqua Lake.

During this reporting period the fourth and fifth ground and aerial data collection missions were successfully conducted in conjunction with Skylab 3 overpasses. Table I lists the ground and aerial missions conducted to date on the program. The ground data of missions 1-5 are of Conesus Lake only; the aerial data include Lake Ontario, Conesus, Chautauqua, Honeoye and Canadice Lakes. Imagery of Lake Ontario and Conesus Lake was also obtained during 1972 as part of the International Field Year on the Great Lakes. The 1972 imagery will be useful for comparative purposes, and available imagery is listed in Table II.

Chlorophyll analyses on samples from missions 1-5 were completed. The Secchi Disk and attenuation coefficient parameters were reduced, as were the majority of the aircraft data. Table III depicts the values of these parameters for Conesus Lake, normally averaged over the five stations established on the Lake [Ground Truth Plan-Skylab Lake Study, 24 April 1973]. No Skylab imagery has been included in the analyses. Receipt of Skylab 3 imagery is anticipated during December.

In some missions the data exhibit a structure from station to station; hence, some care must be used in interpretation of the lake-average data. We estimate the accuracy of the optical data to be: Secchi Disk, $\pm$0.15M; attenuation coefficient, $\pm 0.05M^{-1}$; reflectance, $\pm$0.12 reflectance; and reflectance ratio, $\pm$0.12 ratio. It should be noted that the blue/green and blue/red reflectance ratios drop significantly with increased chlorophyll content [compare missions 1 and 4 with mission 2], as is to be expected.

In addition to the above data, chlorophyll samples and Secchi Disk readings were obtained on Conesus, Canadice and Honeoye Lakes from September to December of 1973. The samples were collected eight times at intervals of about two weeks, usually from a single station on each lake. Initial inspection of these data indicate that Conesus and Canadice are roughly the same order of magnitude in chlorophyll and Secchi disk readings, but Honeoye Lake has considerably higher chlorophyll concentrations and lower Secchi disk values. The reason for the similarity between Conesus and Canadice is not clear because Conesus has hundreds of dwellings on its shore and Canadice has hardly any inhabitants. Because Honeoye is so markedly different from Conesus and Canadice, it would be helpful to continue similar comparisons on all 3 lakes. The data, at least superficially, suggest a much greater productivity in Honeoye Lake.

The water samples for chlorophyll analyses were collected by boat from selected sites in the lake with an "integrated" open tube sampler according to Lund (1949). The samples were kept in the dark during transit, filtered upon return to the laboratory, and either analyzed immediately (fall samples) or stored in the dark in a desiccant and cooler or freezer for later analyses (the summer samples).

The method of chlorophyll analysis follows that of Lorenzen (1967) with only slight modifications. Normally, from 100 to 2000 ml of lake water were filtered through glass fiber filters presoaked with a $MgCO_3$ suspension. After filtration of the water sample the filters were sucked (2-3 min.) to aid in drying, then folded with the algae on the inside, trimmed to remove excess unused filter, and placed in a Thomas grinding tube containing about 3-5 ml of 90% acetone. After grinding

Lorenzen, C. J., 1967. Determination of chlorophyll and pheo-pigments: Spectrophotometric equations. Limnol. Oceanogr., 12:343-346.

Lund, J. W. G., 1949. Studies on Asterionella. I. The origin and nature of the cells producing seasonal maxima. J. Ecol. 37:389-419.

at >1000 rpm for 2 minutes, the pulp and extract were poured and rinsed into a centrifuge tube and made up to 10 ml volume with 90% acetone. To assure complete destruction of the algal cells, the sample was also sonified by a Mullard Sonifier for 3-5 minutes. The sample was then centrifuged at >1000 rpm for 4-5 minutes and the absorbence of the supernatant read at 665 and 750 nm in a 4 cm cuvette in a Beckman DB Spectrophotometer. The sample was acidified with 2 drops of 1 N HCl and read at the same wavelengths again to determine the pheo-pigment fraction of the extract. The equations of Lorenzen (1967) were then utilized to calculate chlorophyll a and pheo-pigment fractions.

It should be emphasized at this point that the above data form a small subset of the total data collected. Hence further analyses are necessary to interpret the data completely and to relate the data to measures of eutrophication. The data have been presented herein to indicate the type of data available and the general internal consistency which seems to be present in the data. During the next reporting period we plan to obtain the Skylab imagery and present a more detailed analysis of all the data.

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Table I. Skylab Ground Truth Missions, Aerial Overflights and Skylab Passes (All Dates 1973)

| Mission | Ground Truth | Aerial Flight | Skylab Pass |
|---|---|---|---|
| 1 | 4 May | 7 May | none |
| 2 | 19 June | 19 June | none |
| 3 | 7 August | 13 August | none |
| 4 | 10 September | 9 September | 9 September, 10 September |
| 5 | 19 September | 19 September | 15 September, 19 September |

Table II. Available Imagery of Lake Ontario and Conesus Lake from 1972 IFYGL Program Sponsored by National Science Foundation. (All Dates 1972)

| | 16 June | 27 June | 17 July | 30 Aug | 11 Sept | 19 Oct |
|---|---|---|---|---|---|---|
| Lake Ontario | x | x | x | x | x | x |
| Conesus Lake | | | x | x | x | x |

Table III. Conesus Lake Measurements (Lake-Average)

| Mission | Chlorophyll a/ mg/M$^3$ | Secchi Disk Transparency (M) | Attenuation Coefficient (M)$^{-1}$ | Percent Reflectance Red | Gn | Blue | Reflectance Ratio** Bl/Gn | Bl/Red |
|---|---|---|---|---|---|---|---|---|
| 1 | 2.32 | 4.1 | 0.96 | 0.9 | 2.0 | 2.8 | 1.4 | 3.1 |
| 2 | 5.22 | 4.9 | -- | 2.0 | 2.6 | 1.9 | 0.8 | 0.9 |
| 3 | 1.42 | 6.7 | 1.02 | * | * | * | * | * |
| 4 | 2.06 | 5.6 | 1.26 | 0.6 | 1.7 | 2.1 | 1.2 | 4.0 |
| 5 | 1.41 | 4.7 | 1.34 | * | * | * | * | * |

* Additional data to be available
** Station average of reflectance ratios